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GENERAL ASSEMBLY
Forty-sixth session
Agenda item 73
REPORT OF THE SPECIAL COMMITTEE TO INVESTIGATE ISRAELI PRACTICES AFFECTING THE HUMAN RIGHTS OF THE PALESTINIAN PEOPLE AND OTHER ARABS OF THE OCCUPIED TERRITORIES

SECURITY COUNCIL
Forty-sixth year

Letter dated 11 December 1991 from the Permanent Representative of Jordan to the United Nations addressed to the Secretary-General

On instructions from my Government, I have the honour to inform you that on the afternoon of Wednesday, 11 December 1991, the Israeli occupation authorities installed on the western wall of the Holy Al-Aqsa Mosque (Al-Buraq Wall) at least eight loudspeakers oriented in the direction of the Mosque and its courtyards. This constitutes an extremely grave violation of the sanctity of this Holy Place, a blatant provocation to the sentiments of Muslims, a desecration of the things they hold most sacred and open interference with the freedom of worship of congregants engaged in their religious observances.

The Jordanian Government would like to call attention to the serious character of this measure. It is being taken in the context of Israel's ongoing practices aimed at the obliteration of Islamic religious landmarks in the Holy City and their Judaization, which will have the same dire consequences as the incident that took place in the precinct of the Haram al-Sharif on 8 October 1990.

I should be grateful if you would have this letter circulated as a document of the General Assembly, under agenda item 73, and of the Security Council.

(Signed) Abdullah SALAH
Ambassador
Permanent Representative

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NOTE BY THE SECRETARY-GENERAL

The Secretary-General has the honour to transmit to the members of the Security Council the attached communication which he has received from the Director-General of the International Atomic Energy Agency (IAEA).

Annex

Letter dated 11 December 1991 from the Director-General of the International Atomic Energy Agency addressed to the Secretary-General

Please find attached the report of the eighth IAEA inspection in Iraq under Security Council resolution 687 (1991). You may deem it appropriate to transmit the report to the members of the Security Council. I remain, of course, available with the Chief Inspector, Mr. Demetrius Perricos, for any consultations you or the Council may wish to have.

(Signed) Hans BLIX

Enclosure

REPORT ON THE EIGHTH IAEA ON-SITE INSPECTION IN IRAQ
UNDER SECURITY COUNCIL RESOLUTION 687 (1991)

11 - 18 November 1991

**SALIENT POINTS**

- The in-field activities related to information on the procurement of equipment essential to the Iraqi nuclear programme continued despite persistent efforts by Iraq to conceal such information. Manufacturers of a number of specific equipment items were identified.

- The Iraqi authorities provided additional answers to questions about weaponization which had been put by the seventh IAEA inspection team and which related mainly to the results of initiator design work and tests, to work on flash X-ray systems, to the theoretical calculations and design options studied, and to the energy released. The answers were vague and general, especially as regards questions deriving from the secret PC-3 progress reports obtained during the sixth IAEA inspection.

- The Iraqi authorities repeated that they had never produced any quantities of 93%-enriched uranium and had never obtained any, other than those known to the Agency, and expressed their concern about the IAEA's findings. The matter is still under investigation.

- Systematic destruction of the EMIS double-pole magnets started, using thermal cutting equipment and with the co-operation of the Iraqi authorities. Basic equipment related to the EMIS and the centrifuge programme was destroyed or rendered harmless. Two high-speed streak video camera systems were removed from Iraq; they are now in storage on the premises of the IAEA.

All fresh highly enriched uranium of Soviet origin was shipped out of Iraq in two consignments, on 15 and 17 November, with the full co-operation of the Iraqi authorities. The airlifting operation was arranged through a contract between the USSR Ministry of Atomic Power and Industry and the IAEA. Only 400 g of 93%-enriched fresh uranium, in the form of 23 fuel plates, and the irradiated fuel elements of French and Soviet origin remain in Iraq.

The verification of nuclear material in the Tuwaitha area was completed, and only 16.7 tons of uranium in waste solutions stored in the Mosul area remain to be properly verified. During evaluation of the nuclear material balance, a number of discrepancies were identified; explanations and clarifications to be provided by the Iraqi authorities were requested in writing.

Monitoring activities initiated during the seventh inspection mission continued during the eighth. It is the opinion of the eighth inspection team that inspection efforts in Iraq should gradually shift to monitoring, with occasional identification and characterization activities performed when new information becomes available. For the time being, certain activities related to the destruction of equipment and removal of the irradiated highly enriched uranium (HEU) fuel (including the 400 g of 93% enriched fresh uranium) should continue in parallel with monitoring inspections and follow-up activities.

**INTRODUCTION**

1. This report summarizes the findings of the eighth inspection carried out by the IAEA under Security Council resolution 687 (1991) with the assistance and co-operation of the Special Commission of the United Nations. The inspection took place from 11 to 18 November 1991 and was headed by Mr. Demetrius Perricos of the IAEA as Chief Inspector. The team consisted of 12 inspectors and 7 supporting staff; it comprised 16 nationalities.

The objectives of the inspection were broadly

- to continue field activities related to the foreign procurement by Iraq of equipment essential to its nuclear programme.

- to further investigate and assess the extent of the Iraqi weaponization studies.

- to continue the destruction or rendering harmless of enrichment- and reprocessing-related equipment.

- to prepare and supervise the removal from Iraq of the fresh HEU fuel of Soviet origin.

- to finalize the verification of nuclear material in the Al Tuwaitha area and perform nuclear material accountancy follow-up activities.

These broad objectives were assigned to two groups within the overall team, with a group leader responsible for co-ordinating the work of each group.

2. The inspection activities related to foreign procurement by Iraq which were initiated in a systematic manner during the seventh inspection mission continued. The inspection revealed new data on procurement and provided additional understanding of the Iraqi procurement strategy, which was based on the use of different State establishments as buyers and contractors, on direct procurement from manufacturers and on indirect procurement through foreign intermediaries. A number of manufacturers of equipment directly related to the programme were identified, but this does not necessarily mean that the manufacturers were also the suppliers.

3. In the area of weaponization, investigation and questioning continued. The Iraqi authorities provided some additional information regarding the design of the initiator and completed the answers to the questions put to them by the seventh team on 12 October 1991. The answers were vague and general, especially as regards questions deriving from the secret Iraqi progress reports obtained during the sixth inspection. Additional facilities were inspected at the Al Atheer site, some of them in depth for the first time. They provided additional evidence that Iraq was investing very substantial resources in a complete programme of weapons development studies.

4. Regarding the destruction of equipment directly related to Iraq's enrichment and reprocessing programmes, activities initiated during the seventh inspection were expanded, the emphasis being on equipment that had been used for the manufacturing of centrifuges or had been procured especially for the centrifuge programme. Destruction of the large double-pole magnets from the EMIS programme began.

5. In compliance with Security Council resolution 687, the fresh HEU fuel of Soviet origin, comprising 68 fuel assemblies of 80% enrichment and 10 of 36% enrichment, was removed from Iraq in two consignments. The Iraqi authorities co-operated fully during preparation of the shipment, the transfer from Tuwaitha to Habanniya airport and loading onto the plane. Confirmation has been received from the USSR Ministry of Atomic Power and Industry that all the fresh fuel arrived in the USSR and it is available for inspection in accordance with the terms of the contract with the IAEA.

6. The verification of nuclear material was completed. With the exception of approximately 16 tons of uranium in waste solutions stored in the Mosul area, the material has been brought together at locations in and around the Tuwaitha site and is now under Agency seals. During verification, a number of discrepancies were identified, related mainly to the balancing of nuclear material processed using Brazilian $UO_2$ as feed.

7. Table I summarizes the chronology of 1991 events related to IAEA activities under Security Council resolution 687 (1991). With the completion of the eighth inspection, all known facilities and sites involved in enrichment and weaponization in Iraq have been inspected. However, owing to the unresolved inconsistencies and ambiguities in statements made by the Iraqi authorities, no assurance can be given that the full

extent of the Iraqi programme has been revealed. It is the opinion of the eighth team that inspection efforts in Iraq should gradually shift to monitoring, with occasional identification and characterization activities performed when new information becomes available. For the time being, certain activities related to the destruction of equipment and removal of the irradiated HEU fuel (including the 400 g of 93%-enriched fresh uranium) should continue with monitoring inspections and follow-up activities.

A full record of the correspondence between the Chief Inspector and the Iraqi counterpart while the eighth IAEA inspection team was in Iraq is given in Annex 1.

**TABLE 1**

**CHRONOLOGY OF EVENTS**
**1991**

| | |
|---|---|
| APRIL 03 1991 | UNSC RESOLUTION 687 |
| APRIL 06 1991 | IRAQ FORMALLY ACCEPTS CONDITIONS OF UNSC 687 |
| APRIL 18 1991 | IRAQ SUBMITS FIRST DECLARATION; DENIES HAVING NUCLEAR-WEAPONS-USABLE MATERIAL |
| APRIL 27 1991 | IRAQ SUBMITS SECOND DECLARATION; FIRST ADMISSION TO HAVING SOME NUCLEAR MATERIAL AND FACILITIES IN ADDITION TO THOSE KNOWN TO THE AGENCY |
| MAY 14-22 1991 | FIRST INSPECTION UNDER UNSC 687; FIRST IAEA TEAM INSPECTS DECLARED IRAQI FACILITIES AND THE TARMIYA SITE |
| JUNE 17 1991 | UNSC RESOLUTION 699, APPROVING IAEA PLAN FOR THE DESTRUCTION, REMOVAL OR RENDERING HARMLESS OF THE ITEMS SPECIFIED IN PARA. 12 OF UNSC 687 |
| JUNE 22-JULY 03 1991 | SECOND IAEA INSPECTION OF IRAQI FACILITIES; ACCESS DENIED AT VARIOUS SITES, IN ONE CASE USING WARNING SHOTS |
| JULY 04 1991 | HIGH-LEVEL UN MISSION REPORTS THAT IRAQI RESPONSE TO REQUEST FOR ACCESS BY INSPECTION TEAM ON JUNE 28 WAS LESS THAN WHAT WAS CALLED FOR BY THE SECURITY COUNCIL |
| JULY 07-18 1991 | THIRD IAEA INSPECTION OF IRAQI FACILITIES |
| JULY 07 1991 | IRAQ SUBMITS THIRD DECLARATION ON ITS NUCLEAR PROGRAMME IN LETTER TO SECURITY COUNCIL, MAINTAINING THAT IRAQ HAD COMPLIED WITH NPT AND IAEA SAFEGUARDS AGREEEMENT; DISCLOSED THREE METHODS OF ENRICHMENT: CENTRIFUGE, CHEMICAL AND ELECTROMAGNETIC |
| JULY 14 1991 | IRAQ SUBMITS ADDITIONAL CLARIFICATION ON ITS THIRD DECLARATION AND PROVIDES LIST OF MANUFACTURING FACILITIES RELATED TO ITS NUCLEAR PROGRAMME |
| JULY 25 1991 | DEADLINE FOR IRAQI DECLARATION OF ALL REMAINING NUCLEAR SITES |
| JULY 28 1991 | IRAQ SUMBITS ADDITIONAL LIST OF NUCLEAR MATERIAL |

| | |
|---|---|
| JULY 27 - AUGUST 10 1991 | FOURTH IAEA INSPECTION OF IRAQI FACILITIES, INCLUDING THE AL FURAT SITE INTENDED FOR PRODUCTION OF CENTRIFUGES, AND THE AL JESIRA PLANT, INTENDED FOR PRODUCTION OF FEED MATERIAL |
| AUGUST 15 1991 | UNSC RESOLUTION 707 WHICH OBLIGES IRAQ, INTER ALIA, TO "HALT ALL NUCLEAR ACTIVITIES OF ANY KIND, EXCEPT FOR USE OF ISOTOPES FOR MEDICAL, AGRICULTURAL OR INDIVIDUAL PURPOSES" UNTIL THE SPECIAL COMMISSION DETERMINES THAT IRAQ IS IN FULL COMPLIANCE WITH UNSC 707 AND PARAS. 12 AND 13 OF UNSC 687 AND THE IAEA DETERMINES THAT IRAQ IS IN FULL COMPLIANCE WITH ITS SAFEGUARDS AGREEMENT WITH THE AGENCY |
| SEPTEMBER 14 - 20 1991 | FIFTH IAEA INSPECTION OF IRAQI FACILITIES MAIN EMPHASIS ON VERIFICATION OF NUCLEAR MATERIAL AND REMOVAL OF THE PRODUCED PLUTONIUM AND INVESTIGATION OF THE CHEMICAL ENRICHMENT PROCESS |
| SEPTEMBER 22-30 1991 | SIXTH IAEA INSPECTION OF IRAQI FACILITIES CONTAINING DOCUMENTATION ON THE IRAQI NUCLEAR PROGRAM AND NUCLEAR WEAPONS DEVELOPMENT |
| SEPTEMBER 24-28 1991 | SIXTH IAEA INSPECTION TEAM DETAINED BY IRAQI AUTHORITIES IN PARKING LOT OF PETROCHEMICAL 3 HEADQUARTERS, BAGHDAD |
| OCTOBER 11 1991 | UNSC RESOLUTION 715, APPROVING IAEA PLAN FOR ON-GOING MONITORING OF IRAQ'S COMPLIANCE WITH RESOLUTIONS 687 AND 707 |
| OCTOBER 11-21 1991 | SEVENTH IAEA INSPECTION OF IRAQI FACILITIES<br>START OF DESTRUCTION OF ENRICHMENT AND REPROCESSING RELATED EQUIPMENT |
| OCTOBER 14 1991 | IRAQ ACKNOWLEDGES THAT RESEARCH AND STUDIES HAD BEEN UNDER WAY IN THE AREA OF NUCLEAR WEAPONIZATION |
| OCTOBER 21 1991 | IRAQ ADMITS THAT THE AL ATHEER SITE WAS BUILT TO SERVE THE WEAPONIZATION PROGRAMME IN ADDITION TO ITS USE AS A MATERIALS PRODUCTION SITE. |
| NOVEMBER 11-18 1991 | EIGHTH IAEA INSPECTION OF IRAQI FACILITIES<br>- ACTIVITIES FOR DESTRUCTION OF EQUIPMENT RELATED TO CENTRIFUGE AND CHEMICAL ENRICHMENT<br>- INITIATION OF SYSTEMATIC DESTRUCTION OF LARGE DOUBLE-POLE MAGNETS RELATED TO EMIS<br>- IN-FIELD ACTIVITIES RELATED TO PROCUREMENT OF EQUIPMENT |
| NOVEMBER 15 + 17 1991 | SHIPMENT FROM IRAQ OF FRESH HEU OF SOVIET ORIGIN |

**FOREIGN SUPPLIES TO THE IRAQI NUCLEAR PROGRAMME**

8. The Iraqi Atomic Energy Commission had, in support of its uranium enrichment and planned weaponization efforts, established a large, secure and highly successful procurement network. The procurement strategy included:

- The use of other Iraqi State establishments as buyers and contractors;

- The placing of orders for equipment (especially manufactured components) directly with foreign manufacturers and indirectly through foreign intermediaries (multiple pieces of some equipment were obtained both directly and indirectly); and

- The utilization of indigenous capabilities to complete the manufacture of some items.

The Iraqi authorities have gone - and are still going to great lengths to prevent the discovery of procurement data. Most procurement-related information has been removed and presumably destroyed.

The large amount of information regarding the Petrochemical-3 (PC-3) project collected during the sixth inspection is still in the process of being translated and evaluated. So far, it appears to include only limited procurement data. Manufacturer name tags have been removed from individual pieces of equipment, and forms of identification such as serial numbers have been filed away. This process is continuing: procurement data on a particular piece of equipment discovered during the seventh inspection were painted over during the interval between the seventh and eighth inspections.

9. The Iraqi authorities now freely acknowledge a political decision calling for efforts to prevent disclosure of the procurement network. They recognize that their efforts have not been entirely successful and that the inspection teams have collected enough information to be able eventually to put the pieces together. Their stated motivation is to protect the relationships with their various suppliers.

10. The casting and rough machining of large iron components for the EMIS programme was done at foundries outside Iraq. The acquisition of these pieces provides a good example of the Iraqi procurement strategy. A large west European foundry received an order from the Iraqi State Electric Establishment for six pieces as shown in Figure 1 (drawing was provided to the IAEA Action Team by the foundry's management). The pieces were produced at the foundry and shipped directly to Iraq. At about the same time, the foundry received an order from a European company for 28 large iron pieces; six of them had specifications identical to those of the pieces produced for the Iraqi State Electric Establishment; twelve of them were halves - along the horizontal axis - of the pieces depicted in Figure 1. These pieces were, in the team's opinion, pre-machined cores for the 1200 mm double-pole magnets installed or destined for installation at Tarmiya. Final machining was done at Al Radwan (Aqba bin Nafi State Establishment) to specifications depicted in Figure 2 (solid core) and Figure 3 ("sandwich" core); the drawings in Figures 2 and 3 were obtained in Iraq. The remaining ten pieces were various parts of the horizontal and vertical return irons for the 1200 mm system. The foundry shipped the components to a seaport in Germany, where they were redirected to their final destination.

11. The foundry's management has indicated that they would have received a larger order from what has turned out to be an intermediary company if they could have met the required production schedule. This, together with the numbers of pieces seen in Iraq, suggests that one or more additional contracts must have been placed with other foundries. The investigation of this matter is continuing.

12. Iraqi officials have described the EMIS component machining work done at the Al Radwan facility as having been carried out under conditions of great secrecy: people simply showed up with components/specifications and removed everything when the work had been completed; they had no idea of what the equipment was for or the identity of the customer. Managers of various Iraqi firms involved in manufacturing aspect of the EMIS programme tell a similar story.

13. A large number of the centrifuge components described in the report of the seventh inspection team, were also obtained from foreign sources. Examples of all major components (rotor tubes, end caps, pin bearings, etc.) removed from Iraq by the third and seventh inspection teams have been and are currently being examined in order to identify the manufacturers. This investigation is vital for follow-up activities to determine the completeness of Iraqi declarations, particularly those relating to carbon fiber rotors.

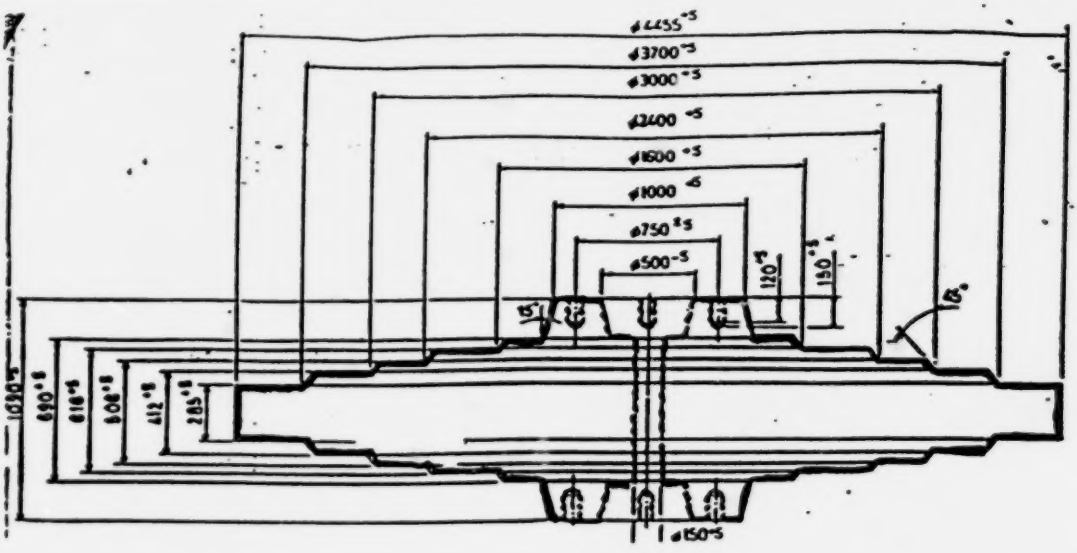


FIGURE 1: CROSS SECTION OF PRE-MACHINED CORE FOR 1200 MM DOUBLE POLE MAGNETS

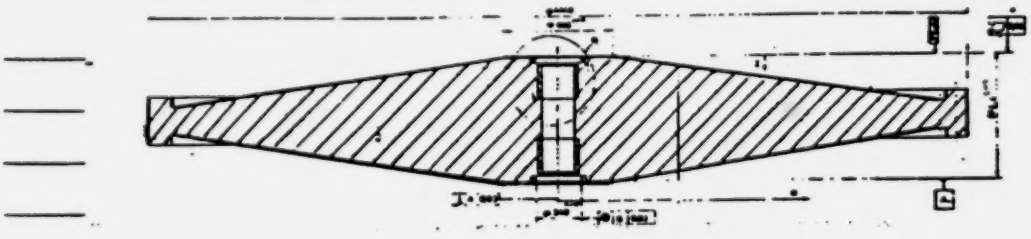


FIGURE 2: CROSS SECTION OF CORE FOR 1200 MM DOUBLE POLE MAGNET MACHINED TO FINAL DIMENSIONS

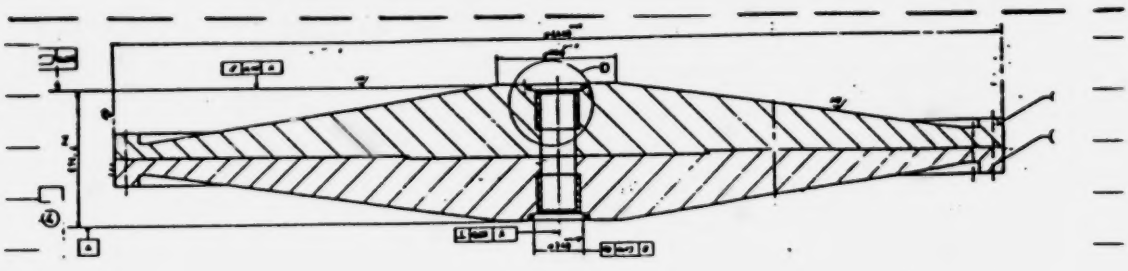


FIGURE 3: CROSS SECTION OF CORE FOR "SANDWICHED" 1200 MM DOUBLE POLE MAGNET MACHINED TO FINAL DIMENSIONS

14. The manufacturers of most equipment used or intended for use in Iraqi efforts to establish a centrifuge production and operation capability have been firmly identified. A summary of some of the more important equipment follows:

- A flow forming machine with application-specific mandrel, expanding mandrel and rollers was manufactured by H & H Metallform Maschinenbau und Vertriebs GmbH.
- An electron beam welder with a special fixture for holding the rotor tube during welding was manufactured by Leybold Heraeus AG.
- Three large CNC machines, two with application-specific fixtures, were manufactured by Neue Magdeburger Werkzeugmaschinenfabrik GmbH.
- A large oxidation furnace with special temperature control features was manufactured by Degussa.
- High frequency converters capable of operating a large number of centrifuges were produced by Acomel GmbH & Co KG.
- Horizontal and vertical balancing machines were manufactured by Dr. Reutlinger & Söhne KG.
- Hand operated, pneumatic and electrically controlled bellows valves were manufactured by NUPRO, VAT AG and Balzer AG respectively.
- Quantities of Krytox, a nuclear grade fluorinated vacuum pump oil were manufactured by Dupont.

Identification of a manufacturer does not necessarily mean identification of the supplier. As pointed out earlier, orders were often placed with manufacturers through intermediaries; this appears to have been the case with at least one of the Magdeburger CNC machines - and a shipping invoice discovered by the inspection team inside the packing crate for a large oxidation furnace appears to provide the name of an intermediary for that procurement.

15. Much of the equipment listed above is multi-purpose in the sense of being useful in a number of manufacturing processes. However, the application-specific fixtures remove most doubt as to the intended uses. Some of the companies may not have been aware that Iraq was the final customer, but the intermediaries certainly were -

and they must have known (or could reasonably have inferred) the intended uses. The large iron pieces destined for the EMIS programme are a different matter: the foundry(ies) may have known that Iraq was the customer, but the iron pieces prior to final machining provided no clue as to their intended use.

Additional procurement-related data are in the possession of the IAEA. This information is being treated as confidential at present since premature disclosure could compromise the ongoing investigation.

16. The manufacturers of large quantities of general-purpose and infrastructure equipment located at Al Tuwaitha, Tarmiya, Ash Sharqat and Al Atheer have been identified. Concerning this equipment, the plan is that follow-up will be limited to instances where the manufacturer appears also to have provided specific services to one or more of these facilities. Most of the equipment at Al Atheer is consistent with the Iraqi declaration that Al Atheer was intended to be a material sciences research centre. Among the exceptions is a large cold isostatic press manufactured by Asea Brown Boveri (which could be used for shaping explosive charges) and very high temperature furnaces (e.g. vacuum-induction furnaces) manufactured by Arthur Pfeiffer Vakuum Technik GmbH. A large number of smear samples from Al Atheer equipment were taken in order to further evaluate the Iraqi declaration that this facility was never used for weapons-related research.

17. The eighth inspection team removed two streak video cameras and related equipment from Iraq. These cameras, manufactured by Hamamatsu, have sufficient speed and resolution for weaponization work. At the time of their removal, they were being used by the Technical University of Baghdad. According to Iraqi authorities, their use was limited to graduate student studies of internal combustion engines; they were never employed in Iraq's weaponization programme. Statements regarding the planned use of the cameras made to the manufacturers at the time of procurement are consistent with declarations made to the inspection team. Smear samples from the cameras may provide further evidence regarding their use.

**ACTIVITIES RELATED TO THE WEAPONIZATION PROGRAMME**

18. On 12 November 1991, the Iraqi authorities provided answers to weaponization questions which had been put by the seventh inspection team on 21 October 1991 -

the last day of its mission - and which related mainly to design studies (including initiator design studies, tamper interface, core and energy release calculations, detonators, hydrodynamic tests, flash X-ray systems and lithium enrichment studies. The answers provided were vague and general, especially as regards questions deriving from the secret PC-3 progress reports obtained during the sixth IAEA inspection.

19. The inspection team requested further information about research or studies on a gun-type weapon design and specific values used in calculations of the design explosion energy and received the following answer:

> "The researched literature indicates that the "Gun" type need more material although the design idea is simpler and the calculation requirements are less. Therefore, the study of this literature led us (Iraq) to concentrate on understanding the implosion type mechanics.
>
> The literature quoted a yield of 20 KT as an approximate figure for the energy released from the implosion device used in Nagasaki. In the calculation models the yield depends on several parameters including the pressure applied on the outer surface, its pulse width, and the device dimensions. Theoretically different yields starting from 1 KT could result depending on these parameters. Since predetermined values for these parameters were not available, a study was performed to determine its effect using one dimensional integrated code and not two dimensional."

20. The inspection team requested information (descriptions and an indication of precise locations) of the mainframe computers which had been used or intended for use at Al Tuwaitha and elsewhere in Iraq in pursuit of the PC-3 programme's objectives (and meeting the Tarmiya and Ash Sharqat requirements). The Iraqi answer was as follows:

> "The Computer Office at Tarmiya was initially designed to accommodate the option of a large computer (mainframe). Due to the special circumstances in operating individual separators, it was discovered through experience that the best condition would be to connect the separators to small dedicated computers. After achieving the steady operating conditions for the separators, the small computers would have been connected through a network located in the above-mentioned office. This approach was adopted at Tarmiya. It also applies to the design of the Computer Office at Ash-Sharqat, although computers were never introduced at this site.
>
> At the Al Tuwaitha site, the large computer was an IBM-370; in addition there were a number of personal computers (PCs) including IBM PS/2. The approach adopted at Al Tuwaitha was to use the computer capability available in the country when needed in addition to the above-mentioned computers.".

This answer is not complete and not compatible with a statement in the PC-3 progress report for the period 1 July - 16 November 1989 which indicates that a mainframe NEC

750 computer was used to run a program obtained from the literature which solves hydrodynamic equations in one-dimensional space and in the presence of a shock wave.

21. In reply to the team's question about the scope of the lithium enrichment programme, the Iraqi authorities stated that the studies had not been directed towards a specific objective and that the $Li^6$ separation activities belonged to the area of general scientific research, with no specific production rate envisaged. The Iraqi reports on this topic were classified secret. Their explanation for the secret classification was that "the outside world would not have understood why they were working on lithium and they were afraid that they would have been severely criticized for undertaking this programme".

22. The inspection team indicated to the Iraqi authorities that it had documentary evidence of several attempts by Iraq to obtain a uranium standard (NBS U930) enriched to 93% in U235. Although these attempts were acknowledged, the fifth and seventh inspection teams had been told that they had not been successful. The inspection team questioned the intended purpose of such a standard, given the lower declared enrichments achieved in the Iraqi enrichment programme, and requested further explanations in view of the persistent appearance of uranium with 93% enrichment in environmental samples collected at and near Al Tuwaitha. The Iraqi authorities stated - as they had on 14 October 1991 - that they had never produced or obtained any quantities (even small ones) of 93%-enriched uranium other than the Tamuz-2 reactor fuel. They indicated their "surprise and worry that such material appeared in the collected samples from the sites" and expressed their willingness to discuss and follow up this matter. The Iraqi side expressed the fear that the sample data are a result of deliberate sabotage by a disgruntled citizen or foreign enemy. This is highly unlikely given the history of sample collection and analysis. The inspection team took additional samples for further analysis. This matter is still under investigation.

Activities at the Al Atheer site

23. In a letter of 14 October 1991 to the seventh IAEA inspection team, the Al Atheer site was declared to be a national centre for research in material science and materials production which provided a missing link in Iraqi industry and technology. The declaration disclosed, however, that the design requirements for the buildings met the needs of a weapons programme, if a decision to launch such a programme were to

be taken in the future. The individual identified as the leader of the nuclear weapons investigation programme was also on the Al Atheer Site Advisory Committee.

24. The task of the eighth inspection team at this site was to complete the site examination by visiting buildings which have not been inspected by earlier teams, to identify and photograph process equipment and analytical instruments, and to interview the staff in the light of earlier discussions and new declarations.

25. Among the buildings visited by the team (see Figure 4) were the Polymer Laboratories (Building 84), the Materials Characterization Building (Building 85), the Internal Explosion Test Laboratory (Building 18) and the associated control building (Buildings 19), the laboratories stated to belong to the Hatteen Establishment (Building 21), the manufacturing workshop (Building 41), the maintenance workshop (Building 40) and warehouses (Buildings 53, 54 and 56), and the High Explosives Test Firing Bunker (Building 33, designated by Iraq as Site 100).

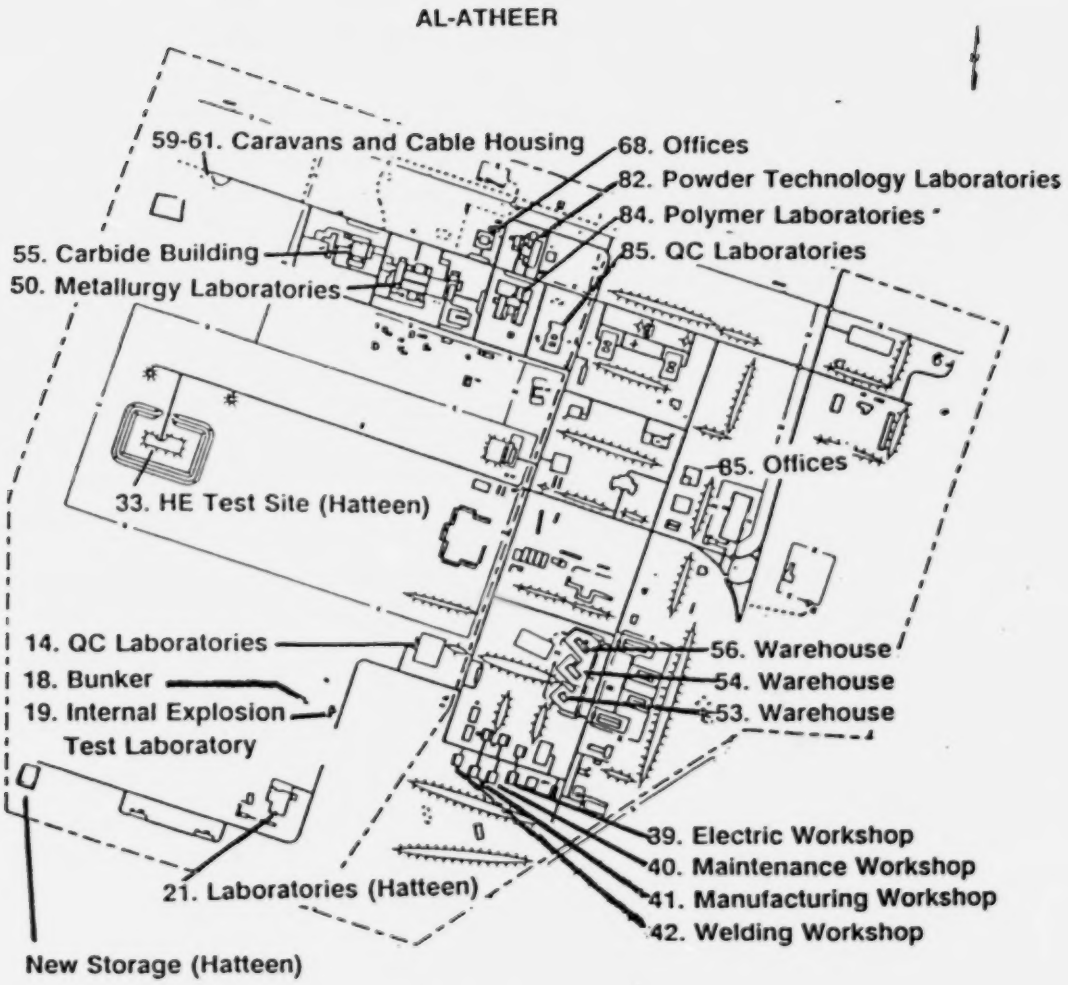
26. The Iraqi management declared that Building 18 was an explosive chamber to be used for the study of the fragmentation of mortar shells up to 155 mm. This explanation does not make sense. Although no final judgement can be made at present about the intended use of this building, in the opinion of the eighth team this multi-million dollar facility was certainly not meant for the fragmentation testing of mortar shells. Further investigations are needed in order to determine the intended use of Buildings 18 and 19, which appear to have been related.

27. The Polymer Laboratories (Building 84) were a large complex about 50% complete. The stated purpose of the building was polymer and plastic development for petrochemical projects. Since construction was in a very early stage, it is not possible to confirm or deny the statement.

28. The warehouses (Buildings 53, 54 and 56) had extensive ventilation and cooling - to prevent chemical hazards due to high temperatures during the summer - and fire detection/suppression (Halon) systems.

29. The Iraqi management have declared that the Carbide Building (Building 55) is for the production of tungsten carbide (100 t/a). The Al Atheer staff indicated that the main customer was to be the Bader plant, as they were planning to produce carbide tools and dyes for industry. Since a lot of the necessary equipment has not been delivered because of the embargo, they are currently considering alternative uses, such as the production of ceramic materials. IAEA inspection teams have pointed out some insufficiencies with regard to hydrogen safety for such a plant, but explanations are

**FIGURE 4**


AL-ATHEER
59-61. Caravans and Cable Housing
68. Offices
82. Powder Technology Laboratories
84. Polymer Laboratories
55. Carbide Building
85. QC Laboratories
50. Metallurgy Laboratories
85. Offices
33. HE Test Site (Hatteen)
14. QC Laboratories
56. Warehouse
18. Bunker
54. Warehouse
19. Internal Explosion Test Laboratory
53. Warehouse
39. Electric Workshop
40. Maintenance Workshop
21. Laboratories (Hatteen)
41. Manufacturing Workshop
42. Welding Workshop
New Storage (Hatteen)

/...

still expected. The Al Atheer staff claimed that the tungsten carbide production was not linked to the PC-3 project, but there is documentary evidence that the two were linked.

30. The Iraqi side now refer to the IAEA Building 33 firing bunker as Site 100. They describe this as a Hatteen facility but Site 100 is mentioned several times in the PC-3 progress reports. Plans for Al Atheer development to make it suitable for weaponization studies must have included Site 100. The Iraqi side has persistently denied that any improvement or repair work has been done at this site since it was bombed even though the inspection team has unequivocal evidence to the contrary. The damage to the bunker is repairable.

31. According to the PC-3 progress report covering the period 1 January - 31 May 1990, the Al Atheer site was opened in May 1990. The inspection teams have taken samples to determine whether equipment and facilities were used for weaponization-related research; the sample analysis results are not yet available. Equipment such as isostatic presses and high-temperature furnaces have been identified and placed under IAEA seal. Action is being taken the determine - with the help of the manufacturers - the delivery dates and the number of equipment items and accessories supplied to Iraq. This information and the analytical results will be used in determining whether the site ever started operations.

**DESTRUCTION OF EQUIPMENT/COMPONENTS**

32. Activities, begun during the seventh inspection, to destroy or render harmless equipment/components associated with the Iraqi uranium enrichment programme continued during the eighth inspection. The Iraqi authorities, anxious to salvage what they can, made a number of suggestions as to how specific equipment could be rendered useless for enrichment applications and still be available for other uses (with appropriate monitoring). In some cases, the suggestions were accepted for further evaluation; in other cases, they were not and an immediate decision to destroy was taken. The centrifuge-related equipment destroyed during the eighth inspection included:

- Three large high-frequency converters stored at the Ash Shakyli warehouse;
- A vertical balancing machine and the bed for the horizontal balancing machine;
- The jig for a MIG (Metal Inert Gas) welder specially designed for welding aluminium centrifuge casings;

- A mandrel, the expanding mandrel and roller bearings used in the flow forming manufacture of maraging steel rotor tubes (the holding collar of the mandrel was removed from Iraq for further evaluation of the extent of use);

- An electron beam welder fixture designed to hold maraging steel rotors while the end caps are being welded on;

- A rotating spindle and mandrel for the CNC machine used to cut maraging steel rotor tubes to length, and the special collet and whirling head from the CNC machine used to manufacture molecular pumps.

33. The destruction of the application-specific fixtures associated with the centrifuge manufacturing equipment has rendered this equipment useless for centrifuge applications. However, uncertainty remains regarding the completeness of Iraqi declarations as to the number of machine-tools of various types existing in Iraq. Follow-up investigations with equipment manufacturers and suppliers may help. The remaining equipment has not been released for use; it is under Agency seal pending a final decision.

34. At the conclusion of the seventh inspection, the destruction of EMIS components stored at Al Nafad was complete except for the large iron cores of the double-pole magnets and a number of machined parts of the vertical return iron. Several attempts to destroy these pieces were unsuccessful. The solution found was high-temperature cutting fueled by large amounts of oxygen. Destruction of the magnet cores by three 1-1.5 meter long cuts through each has started; will require several weeks since this is a slow process. By the end of the inspection, eight cores had been destroyed. The Iraqi side, which co-operated fully, will continue this work and it is expected that all components will have been destroyed by the time the next IAEA team arrives.

35. Equipment that had been used in Iraqi chemical separation work was destroyed. The mixer-settlers in Building 9 at Al Tuwaitha, which had been used in reprocessing research, were destroyed by filling the mixer and settler chambers with Araldite. This was a difficult task because of the high level of radioactive contamination. A number of hot cells were rendered harmless, at least for the time being, by the cutting and removal of manipulators. The manipulator parts are under seal in a central location.

## NUCLEAR MATERIAL VERIFICATION ACTIVITIES

Location C, Buildings 1 and 2 (Nuclear Material Storage)

36. The decision was taken to verify the nuclear material on the basis of a random sampling plan with a 90% confidence level and a goal quantity corresponding to 1 ton of uranium. The verification activities were completed during the eighth inspection and are summarized in Table 2. Only 16.7 tons of uranium contained in waste and stored in a petrol tank in the Mosul area remain to be properly verified. During compilation of the nuclear material balance, a number of discrepancies were identified; the Iraqi authorities were requested, in writing, to provide explanation and clarification in due course. Details of the verification and the discrepancies are given in Annex 2.

## REMOVAL OF NUCLEAR MATERIAL FROM IRAQ

37. Representatives of the USSR Ministry of Atomic Power and Industry and staff of the IAEA, with the help of the Iraqi counterparts, made all the preparations necessary for the shipments, packing all Soviet-made fuel assemblies into the original drums and sealing them. The 23 plates of a Tamuz-2 fuel assembly were placed in a drum, which was sealed pending future removal. To comply with IAEA nuclear safety requirements, the material to be removed from Iraq was taken to Habanniya in two convoys of special trucks and flown out in two shipments. The first consignment consisted of six drums, each containing seven fuel assemblies (80% enrichment); the second consisted of five drums, one containing ten fuel assemblies (36% enrichment). Two Soviet AN-12 cargo planes arrived at Habanniya airport on 15 and 17 November. The drums were placed in special Soviet-constructed overpacks designed to fulfill the more stringent requirements formulated in the latest IAEA transport regulation. At present, the only remaining nuclear material stored at Location A are 23 MTR plates (400 g uranium, 372 g U235).

TABLE 2

Summary of Inspection Results

| MATERIAL TYPE | | ORIGIN Processing Site | PRESENTED TO TEAM NO. | DECLARED INVENTORY | | | VERIFIED INVENTORY | | | | LEFT UNDER SEAL Y/N |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | No. of Items | COMPOUND Weight (kg) | ELEMENT Weight (kg) | VERIFICATION I | NDA | B | D | |
| NATURAL URANIUM | Yellow Cake | Niger | 1,3,8 | 858 | 276844 | 199934 | 858 | 329 | 122 | 41 | Y |
| | | Portugal | 1,3 | 916 | 286435 | 213016 | 915 | 322 | 127 | 48 | Y |
| | | Al-Qaim | 3 | 12 | 3000 | 2200 | 12 | 12 | 12 | 5 | Y |
| | $UO_2$ Pellets | Previous Safeguards | 4 | 47 | | 14 | 1 | 1 | 1 | 1 | Y |
| | $U_3O_8$ Powders | | 1,3 | | | 1162 | 10 | 6 | 3 | 3 | Y |
| | $UO_3$ Powders | | 1 | | | | 22 | 18 | 7 | 3 | Y |
| | $UO_4$ Powders | | 1 | | | | 1 | 1 | 1 | 1 | Y |
| | Mx U Oxides | | 1 | | | | 6 | 6 | 3 | 2 | Y |
| | $UO_4$ Slurry | | 4 | | | | 8 | 8 | 8 | 2 | Y |
| | $UO_4$ Filters | | 4 | 37 | 100 | | 37 | | | 1 | Y |
| | $UO_2$ Powders | Brazil | 3,4 | 227 | 22578 | | 227 | 48 | 227 | 10 | Y |
| | U Metal | Brazil/Al.T.Bld #10 | 4 | 22 | 1000 | 1000 | 22 | 7 | 22 | 3 | Y |
| | Liquid Waste | Brazil/Al.T.Bld #15 | 4 | 4 | | 6 | 4 | | | 1 | Y |
| | $UF_6$ | Brazil/Al.T.Bld #15 | 3 | 1 | 0.465 | | 1 | 1 | 1 | 1 | Y |
| | $UF_4$ Powders | Brazil/Al.T. Bld #15 | 1,3,4 | 5 | 379 | | 3 | 3 | 3 | 6 | Y |
| | $UO_2$ Powders | | | | | | 1 | | 1 | 2 | Y |
| | Mixed U Pdrs | | | | | | 1 | | 1 | 6 | Y |
| | $UCl_4$ | Brzl./Al.T. Bld #85 | 3,4 | 43 | 1520 | | 43 | 41 | 43 | 10 | Y |

I = item counting, B = weighing, D = sample analysis, NDA = non-destructive analysis

TABLE 2

Summary of Inspection Results

| MATERIAL TYPE | | ORIGIN Processing Site | PRESENTED TO TEAM NO. | DECLARED INVENTORY | | | VERIFIED INVENTORY | | | | LEFT UNDER SEAL Y/N |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | No. of Items | COMPOUND Weight (kg) | ELEMENT Weight (kg) | VERIFICATION | | | | |
| | | | | | | | I | NDA | B | D | |
| NATU | ADU Powders | Brazil/Al.T. Bld #85 | 3 | 31 | 1850 | | 11 | 11 | 11 | 12 | Y |
| | ADU Scrap | | | | | | 4 | 4 | 4 | 5 | |
| | $UO_3$ Powders | | | | | | 2 | | 2 | 2 | |
| | $U_3O_8$ Powders | | | | | | 1 | | 1 | 1 | |
| EU | Liquid Recovered | Brazil/Al.T. Bld #85 | 3 | 2 | | 1.015 | 2 | | 2 | 29 | Y |
| DU | | | | | | 11.55 | | | | | |
| NU | | | | | | 0.78 | | | | | |
| NATURAL URANIUM | ADU Powders | Al-Qaim/Al-Jesira | 4 | 3 | 220 | | 3 | 3 | 3 | 4 | Y |
| | $UO_4$ Powders | | 3 | 2 | | | 2 | 1 | 2 | 4 | Y |
| | | | | 9 | 2255 | 1533 | 9 | 9 | 9 | 3 | |
| | $U_3O_8$ Powders | | 4 | 4 | 100 | 84 | 4 | 4 | 4 | 1 | Y |
| | $UCl_4$ | | 3 | 8 | 1207 | 780 | 8 | 8 | 8 | 3 | Y |
| | $UO_3$ Powders | | 3 | 44 | 2050 | 1640 | 8 | 8 | 8 | 10 | Y |
| | $UO_2$ Powders | | | | | | 2 | 2 | 2 | 1 | Y |
| | Mx U Oxides | | | | | | 19 | 19 | 19 | 2 | Y |
| | $UO_2$ Powders | | 3 | 409 | 96967 | 84446 | 409 | 307 | 97 | 46 | Y |
| | Scrap | Al-Tuwaitha | 3 | 1 | | | 1 | | 1 | 1 | Y |

I = item counting, B = weighing, D = sample and analysis, NDA = non-destructive analysis

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**OTHER ACTIVITIES**

Inspection at Tarmiya

38. An inspection of the Tarmiya EMIS site took place in order to:

- Take verification samples from the uranyl nitrate solutions stored in tanks in Building 62 (at the time of the third inspection, these solutions were in plastic containers buried in a field adjacent to the Tarmiya site; the solutions have been moved back to the storage tanks at the request of the inspection team);
- Assess the condition of and take samples from the mixer-settlers in Building 57;
- Place an identifying seal on the Delta precision measuring device installed in Building 271; and
- Monitor the clean-up of Tarmiya buildings and identify any new uses.

39. Samples were taken from the most highly enriched uranyl nitrate solution (5-10% U235) and most depleted (~.1% U235). The container with the 5-10% solution was sealed. The mixer-settlers in Building 57 had been moved to Al Tuwaitha; the reasons given for the move are vague and this matter should be followed-up. The Delta measuring device has been dismantled and placed in crates, which are now being stored in the room where the device had been installed; the Iraqi side indicated that this was done because of the poor environment and that the device would not be removed without prior consultation with an inspection team.

40. The overall level of activity at the Tarmiya site appears to be modest. There has been little change since the third inspection, in July. Building 245 is now being used for the manufacture and repair of transformers.

Inspection at the Badr State Establishment

41. The Badr State Establishment was one of the partners (with Daura) in the development of the Al Furat centrifuge manufacturing and testing facility. Besides the organizational connection, ten of the 13 CNC machines known to have been associated with the development of Iraq's centrifuge manufacturing capability are stored here (Building 24). These machines had been inspected previously and identifying seals had been placed on each machine during the seventh inspection. The purpose of the 14 November visit was to check the seals and search for additional supplier information.

42. A seal on one of the machines was found to have a broken wire; the Iraqi side could offer no explanation. The seal was replaced. The remaining seals were intact. The manufacturers of the machine components were noted, but most of the components are of general use. One exception may be the main spindle drive. Information on the manufacturer of the main spindle drive had been stripped from the drive housing of every machine but one. This information was recorded.

Inspection at the Aqba bin Nafi State Establishment

43. The Aqba bin Nafi State Establishment consists of general mechanical and engineering workshops at three locations - Al Ameen at Badr, Al Radwan near Khandri and Al Amir at Al Fallujah. The headquarters of the Establishment is at Al Ameen, within the boundaries of the Badr plant.

44. Prior to the Gulf War, the Al Ameen portion of the Aqba bin Nafi State Establishment had three primary functions:

- The assembling of CNC machine tools;
- The maintenance of T-72 tanks and the construction of parts for their repair; and
- The manufacture of parts for hydroelectric power stations.

The assembling of CNC machine tools was carried out under licence from a west European company. About 5-6% of the parts were manufactured at Al Ameen and the rest were imported. The control panels were manufactured at the Salladine Establishment, which was inspected by the seventh team.

45. The Establishment is still assembling CNC machines. The Iraqi management indicated that the contracts for tank maintenance and repair and the manufacture of hydroelectric power station parts have been cancelled. Work for the Iraqi Atomic Energy Commission was apparently done only at the Al Radwan and Al Amir facilities. The Director of the Establishment described the conduct of the work in much the same terms as the Director of the Salladine Establishment - i.e. people showed up with plans and materials, they did not identify themselves, and they removed the plans and product when the work had been done.

46. The facilities appear consistent with Iraqi statements. Modest damage was sustained during the war, but most of it seems to have been repaired. The facilities include large, modern cleaning and welding shops. The welding shop is dominated by a huge electron beam welder with a chamber approximately 10 meters on a side. All equipment looked as though it had been in place for quite some time.

Sampling at Al Tuwaitha buildings

47. The seventh inspection team had received a request from the Iraqi side for permission to demolish a number of Al Tuwaitha buildings that had been severely damaged during the war - Buildings 9, 15, 55, 60, 64, 72, 73 and 74 and the Annex to Building 15. Permission was given by the IAEA after consultation with the Special Commission. The inspection team visited each of these buildings, to which access is limited because of severe damage, in order to collect additional samples (24 samples, a combination of smears and environmental samples, were taken). A number of other samples, unrelated to the demolition request, were taken at Location C and in Building 86.

Short-notice inspection

**The "Al-Amil" Liquid Nitrogen Plant**

48. Information collected during the sixth inspection revealed the existence of a plant named "project 7307", built in 1988-89, to provide liquid nitrogen for the EMIS diffusion pumps at Tarmiya. This plant, also called "Al Amil", was the subject of a short-notice inspection on 17 November 1991 following designation by the Special Commisssion. The team was accompanied by the plant manager during the inspection.

49. The Al Amil facility, located about six kilometers west of Tarmiya is a small, single-purpose and apparently well-run facility for - as indicated - the production of liquid nitrogen. With the destruction of Tarmiya and the cessation of the Iraqi EMIS programme, other customers for the liquid nitrogen were found and production continued unabated. There are plans to expand the capacity of this facility. Substantial amounts of used equipment have been brought to this location from one or more other sites and are being stored pending installation. The Al Amil facility was constructed with the help of a foreign firm.

**The Karkh water treatment plant**

50. The Karkh water treatment plant borders on the Al Amil liquid nitrogen facility and was covered by the same short-notice inspection designation. The Karkh plant was built to expand and improve the water supply to Baghdad. It was essentially complete at the time of the Gulf War, when the remaining contractor personnel left Iraq. A number of foreign firms were involved, the general contractor being Continental Construction Limited (India). The plant manager described the construction work as a 1.5 billion dollar project resulting in the largest water purification plant in the Middle East and one of the largest in the world. The capacity is about 2 million gallons of water/day.

51. The Karkh water treatment plant is well constructed and laid out, with a number of indications of a well-run facility (e.g. attention to industrial safety practices). All major buildings were inspected. None of the buildings showed any sign of functional change or of recent modification to utilities or ventilation systems. Nothing that might indicate a connection with the Iraqi nuclear programme was observed. There are some temporary structures at the site which, according to Iraqi statements, belong to the various contractors. They were inspected and the contents found to be consistent with the stated purpose. The plant manager indicated that the buildings and their contents would be disposed of upon return of the contractors.

**Inspection at Al Qa Qaa**

52. The six bunkers containing 255 tons of HMX high explosive were visited. The seals on the bunkers were checked and verified by seal replacement.

## ANNEX 1

## LIST OF REQUESTS SUBMITTED AND DECLARATIONS RECEIVED DURING THE 8TH IAEA INSPECTION

8-1. Mr. Al Hajjaj to Mr. Perricos on 911112 - response to the letter of 911021 providing information on the weaponization studies, hydrodynamic calculations made, Li-6 laboratory experiments, exploding wire laboratory studies, energy sources, initial tests of initiators, and studies on flash X-ray systems.

8-2. Mr. Al Hajjaj to Mr. Perricos on 911112 - response to the letter of 911021 providing information about equipment ordered for Powder technology laboratory, Ceramic slip casting laboratory, Sample preparation laboratory, and Casting building at Al Atheer. The letter includes some technical specifications of the equipment.

8-3. Mr. Al Hajjaj to Mr. Perricos on 911112 - response to the letter of 911021 providing information about the tests performed by PC-3 at Hatteen HE Test bunker site in Al Atheer during the period of March - May 1990.

8-4. Mr. Al Hajjaj to Mr. Perricos on 911112 - response to the letter of 911021 providing information about the design and completion of the Ash Sharqat site.

8-5. Mr. Perricos to Mr. Al Hajjaj on 911112 - acknowledging the receipt of U-233 and neptunium samples.

8-6. Mr. Zifferero to Ambassador Alkital on 911113 - regarding the levelling of certain buildings at Al Tuwaitha.

8-7. Mr. Perricos to Mr. Al Hajjaj on 911114 - requesting information about the location and quantities of bismuth used for the $Po^{210}$ production, list of graphite machining equipment moved to the Al Rabie Plant, removal of the streak video system, the location of EMIS ion sources and collectors of building 80, the return of microfiches taken from the 6th IAEA inspection team by the Iraqi authorities, detailed schedule for the levelling of damaged buildings, and a site visit to such buildings, declaration on the Abu Sukhayr mine ore processed. In addition, a request for proposals regarding the destruction, and rendering harmless of equipment related to the centrifuge programme, research and development work on the use of cerium sulphide, research and study on the gun type design, hydrodynamic calculations, details of $Po^{210}$ initiator design, and clarifications regarding the appearance of 93 % U-235 in environmental samples taken at Al Tuwaitha.

8-8. Mr. Perricos to Mr. Al Hajjaj on 911115 - documenting that the IAEA has shipped the first consignment of fresh highly enriched uranium from Iraq.

8-9. Mr. Perricos to Mr. Al Hajjaj on 911116 - requesting information on mainframe and other computing power used in the nuclear programme, additional tritium sources located, uranium metal production, and referring to an Al Atheer programme progress report movement of people and equipment from Al Tuwaitha to Al Atheer.

8-10. Mr. Perricos to Mr. Al Hajjaj on 911116 - acknowledging the receipt of the holding piece of a destroyed mandrel from the centrifuge flow forming machine.

8-11. Mr. Perricos to Mr. Al Hajjaj on 911117 - documenting that the IAEA has shipped the second consignment of fresh highly enriched uranium from Iraq.

8-12. Mr. Al Hajjaj to Mr. Perricos on 911117 - as a response to para 3 of the letter 911114 (item 8-7 above) providing information of the use of the streak cameras.

8-13. Mr. Al Hajjaj to Mr. Perricos on 911117 as a response to the letter 911116 (item 8-9 above) providing information on the mainframe and other computers at Al Tarmiya, Ash Sharkat and Al Tuwaitha, tritium sources, and tests and manufacturing of uranium metal at Al Tuwaitha.

8-14. Mr. Al Hajjaj to Mr. Perricos on 911117 - as a response to the letter of 911114 (item 8-7 above) providing information on Bismuth in Iraq, tools for graphite machining moved to Al Rabie Laboratory, EMIS ion sources from Al Tuwaitha, returning microfiches taken from the 6th IAEA team, timetable for the building removals at Al Tuwaitha, processed uranium ore from Abu Sukhayr mine, research conducted with cerium sulphide, gun type weapons, polonium used for initiators, and that they have never produced or obtained any quantities of 93% enriched uranium.

8-15. Mr. Perricos to Mr. Al Hajjaj on 911118 - acknowledging the receipt of 156 pcs of microfiches taken from the 6th IAEA inspection team, a segment sample of a ring from the center of a double pole (EMIS), and 3 pcs of vacuum valves.

8-16. Mr. Perricos to Mr. Al Hajjaj on 911118 - requesting additional information on the receipt of yellow cake from Portugal, differences found in pellets, $UO_4$ slurry and filters, $UO_3$ of Al Mosul, ADU of Al Mosul, $UO_4$ samples from Al Qaim, scrap, $UO_2$ from Brazil, $UF_4$, ADU and $UCl_4$ made from material of Brazilian origin, uranium penetrators, and retained waste at Al Mosul.

8-17. Mr. Perricos to Mr. Al Hajjaj on 911118 - requesting comments on the organization and functions of group IV of PC-3, which have been summarized using data from reports provided by Iraq.

8-18. Mr. Perricos to Mr. Al Hajjaj on 911118 - acknowledging the receipt of Hamamatsu streak video system components to the IAEA custody.

8-19. Mr. Perricos to Mr. Al Hajjaj on 911118 - requesting the destruction and rendering harmless of the EMIS related equipment, reminding the need to check water levels in storage tanks at location B, covering of the $Po^{210}$ glove-boxes at Al Tuwaitha, and acknowledging the receipt of beryllium.

8-20. Mr. Al Hajjaj to Mr. Perricos on 911125 - referring to the discussions on the liquid uranium waste and informing that the containers are ready for shipment from the Al Mosul facility.

8-21. Mr. Al Hajjaj to Mr. Perricos on 911114 - informing about the reconstruction of buildings 10, 67, 82 and 90.

## ANNEX 2

## NUCLEAR AND OTHER MATERIAL VERIFICATION ACTIVITIES

Location C, Buildings 1 and 2 (Nuclear Material Storage)

Yellow cake inventory

a) Originating from Niger (199.9 tonnes uranium content in 858 drums). Part of this material (99.7 tonnes uranium content, 428 drums) had been stored at Tikrit and was moved to Location C, where the eighth team verified it.

b) Originating from Portugal (213 tonnes uranium content in 916 drums). Weighing showed that there was no difference between the shipper's weight-list and the IAEA weighing, with the exception of about 40 kg in one damaged drum. However, 100 drums have been painted and the identification numbers erased, so that there is no way of comparing the weights with the shipper's list. No adequate explanation has been given by Iraq concerning this issue.

c) Originating from Iraq - Al Qaim (2.2 tonnes uranium content in 12 drums). On 7 July 1991, the Iraqi side declared that a total of 164 tonnes of yellow cake was produced at Al Qaim, out of which 161 tonnes were processed in Al Jesira and the remaining 3 tonnes were stored at Tikrit. During the eighth inspection, these 3 tonnes of yellow cake (2.2 tonnes uranium content) in 12 drums were brought to Al Tuwaitha, verified and stored at Location C.

Nuclear material previously placed under Agency safeguards

a) 1 box containing 14 kg of uranium as $UO_2$ pellets (excluding 8.5 kg kept at the New Storage - Building 50 at Al Tuwaitha).

b) 37 filters containing $UO_4$ powder with a declared weight of 100 kg uranium content.

c) Uranium oxides. A total of 1,162 kg of uranium in various oxide forms in 46 containers.

The following discrepancies have been found regarding the material previously under safeguards:

a) The total uranium content in the $UO_2$ pellets presented by the Iraqi side is 33.9 kg (including 8.5 kg stored at the New Storage), which does not correspond to the 22.5 kg reported by the Iraqi side during the November 1990 IAEA safeguards inspection.

b) The weight of the 8 drums containing $UO_4$ slurry amounts to 1180kg. Additionally, 100 kg of uranium contained as $UO_4$ in 37 filters were declared and presented to the fourth team. During the eighth inspection, the Iraqi side declared orally that this material belonged to the inventory previously under safeguards. If that is the case, this amount is greater than what was previously under safeguards.

A written explanation of these discrepancies was requested on 18 November 1991.

$UO_2$ of Brazilian origin

A total of 27 tonnes of $UO_2$ was declared by the Iraq side in the 7 July 1991 declaration, and 22 578 kg (declared value) of $UO_2$ were presented in 227 containers as part of this material. The remaining 4422 kg were declared as having been processed in Al Tuwaitha Buildings 10, 15 and 85. The verification details are presented in Figure I.

Material processed in Building 10 - Al Tuwaitha

One tonne (approximately) of uranium metal in 22 containers is stored at Location C. It was processed by the reduction of $UF_4$ with magnesium. Part of this material (19.7 kg in one box containing uranium metal pieces cast and/or machined to various shapes) is stored in the New Storage. Additionally, the Iraqi side declared that 3.5 kg of uranium metal had been used in the production of armour-piercing shells.

Material processed in Building 15 - Al Tuwaitha

One cylinder contained 465 g of $UF_6$ produced by fluorination of $UO_2$. The Iraqi authorities also admitted to having tested the dry method for the fluorination of $UO_2$ using Freon gas, but no material produced this way was presented.

**FIGURE I**

**Material processed using UO2 of Brazil Origin**




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379 kg of $UF_4$ originally contained in 5 drums had been repackaged in three drums. Additionally, 73 kg of $UO_2$ and 30 kg of mixed uranium oxides were found inside the $UF_4$ containers.

Four containers with an aqueous solution of uranium slurry with a total uranium content of 6 kg were presented.

Material processed in Building 85 - Al Tuwaitha

1520 (compound weight) of $UCl_4$ were presented in 43 containers.

1850 kg of ammonium diuranate (ADU) contained in 31 drums were presented. The drums were emptied and the material placed in 11 drums and four containers with ADU scraps. Furthermore, two containers with 58 kg of $UO_3$ and one container with 39 kg of $U_3O_8$ were found inside the drums with ADU.

Material from the EMIS enrichment programme, in the form of liquid solutions and small sample bottles with powders containing natural, depleted and enriched uranium was presented in two drums.

The following discrepancies were found in the verification of the material of Brazilian origin:

a) The Iraqi side declared 22 578 kg of $UO_2$ remaining out of the 27 000 kg received from Brazil. After weighing of all the drums, the correct amount was found to be 23 348 kg.

b) The drums with $UF_4$ were found to contain the following material:

$UF_4$ :- 284 kg
$UO_2$ :- 73 kg
Mixed uranium oxides :- 30 kg

The declared contents were 379 kg of $UF_4$ (compound weight). The Iraqi side stated that the mixed uranium oxides were rejects from early development work.

c) All drums containing $UCl_4$ were weighed and, instead of the declared amount of 1520 kg, it was found that the amount contained was in excess of 3700 kg.

d) The Iraqi side declared 1850 kg of ADU. All drums were emptied and the following material found:

ADU :- 2,580 kg
ADU scrap :- 148 kg
$UO_3$ scrap :- 58 kg
$U_3O_8$ :- 39 kg

A written explanation of the discrepancies has been requested.

Figure I shows schematically the material processed at Al Tuwaitha using $UO_2$ of Brazilian origin. It compares the Iraqi declarations of material with the results obtained by weighing all the containers in which the produced material was presented.

On the basis of standard concentration values, it has been found that 5795.3kg uranium content were presented by the Iraqi side and that the uranium in the processed $UO_2$ amounted to 3214 kg.

A written explanation of this discrepancy has been requested.

Processed material originating from Al Qaim

This material, produced by the processing of 161 tonnes of yellow cake from Al Qaim, includes:

- 2250 kg of $UO_4$ in nine drums sent from Al Jesira to Tikrit and then moved to Location C during the eighth inspection.
- 96 095 kg of $UO_2$ presented to the third inspection team in 409 drums.
- 220 kg of ADU presented to the fourth team in three drums.
- 2050 kg of $UO_3$ declared on 7 July 1991 and presented in 44 drums. All the drums have been emptied and the $UO_3$ placed in eight drums. In addition to the $UO_3$, 200 kg of mixed uranium oxides in 19 containers were found. Also, 58 kg of $UO_4$ were found inside two $UO_3$ containers.
- 1207 kg of $UCl_4$ in eight containers were declared on 7 July 1991.
- 100 kg of $U_3O_8$ were presented in four containers.
- Two drums containing $UO_4$ samples were presented.

The following discrepancies were found with regard to the material of Al Qaim origin:

a) The amount of $UO_2$ declared on 7 July, 1991 was 96095 kg (in 409 drums). However, in a list presented by the Iraqi authorities later, the amount was 96967kg (in 409 drums).

b) The amount of ADU declared was 220 kg. However, the amount weighed was 317 kg.

c) The amount of $UO_3$ declared was 2050 kg. All containers were emptied and the following material found:

$UO_3$ :- 2020 kg
Mixed uranium oxides :- 200 kg
$UO_4$ :- 58 kg

d) Two drums containing 88 kg of $UO_4$ in sample bottles were presented to the third team but not included in any declaration.

Figure II shows schematically the flow of material into and out of Al Jesira. It compares the Iraqi declaration of material produced at Al Jesira with results obtained by weighing the material.

It was impossible to verify the material (16.73 tonnes of uranium) contained in the uranium waste tank but, on the basis of the value given by the Iraqi authorities, it was estimated that 105.735 tonnes of uranium were produced - not the declared amount of 104.65 tonnes.

The explanation given by the Iraqi authorities is that they overestimated the amount of uranium waste. In order to clarify the situation, they have proposed emptying the uranium waste tank and carrying out an accurate measurement of the uranium quantities.

One drum containing 53 kg of scrap presented to the third team was not included in any declaration. A written explanation about the origin of this material has been requested.

These verifications - summarized in Table 2 of the report - complete the activities required in order to verify the material brought to Location C. However, the results of destructive analysis, careful evaluation of all the data obtained during the different inspections and the discrepancies described above may call for some additional verification activities.

All the material at Location C has been left under seal. Figures III and IV show the arrangement of the nuclear material at Location C (Buildings 1 and 2).

**FIGURE II**

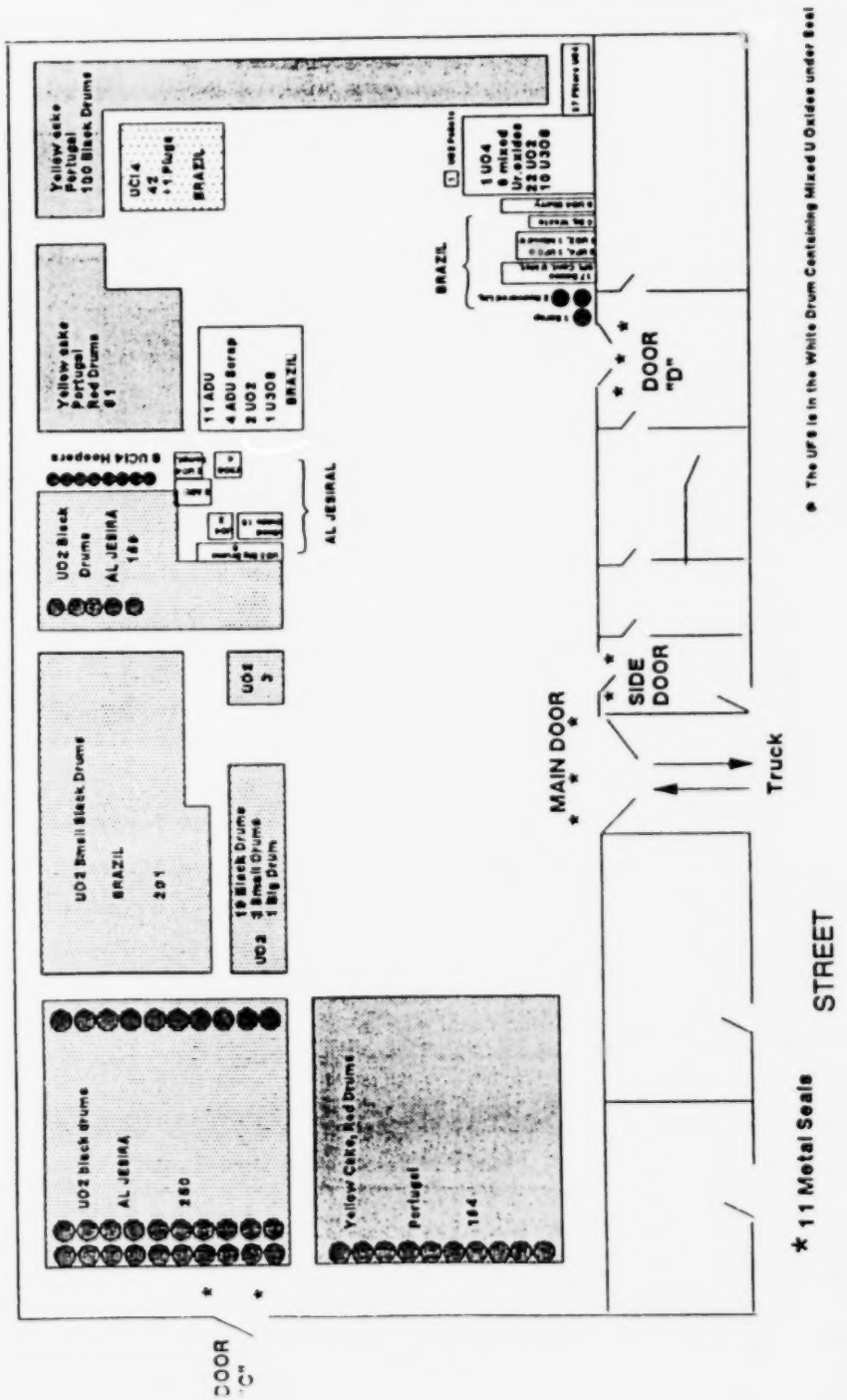
**Flow Material in and out of AL JESIRA**


Verified by weighing
AL QAIM
104.65 t NU as UO4
Declared value
AL-Jesira-Building 8
83.542 t NU as UO2
1.640 t NU as UO3
0.160 t NU as Mixed uranium oxides
0.048 t NU as UO4
0.084 t NU as U3O8
1.533 t NU as UO4 to Tbilisi
0.196 t NU as UO2 to AL-Tuwaitha to UCL4 Plant
0.9 t NU as UO2
AL-Jesira
Waste retention Basin
(Building 11, 12 and 13)
777 retained waste
AL-Jesira-UCL4 Plant
0.78 t NU as UCL4
* The U content of the mixed uranium oxides and the UO4 found inside the UO3 drums are based on estimated concentration of 90 %. The remaining values are those used in the inspr declaration.
Declared
AL QAIM
104.65 t NU as UO4
Declared value
AL-Jesira-Building 8
83.542 t NU as UO2
1.64 t NU as UO3
0.084 t NU as U3O8
1.533 t NU as UO4 to Tbilisi
0.196 t NU as UO2 to AL-Tuwaitha to UCL4 Plant
0.9 t NU as UO2
AL-Jesira
Waste retention Basin
(Building 11, 12 and 13)
16.73 t as retained waste
AL-Jesira-UCL4 Plant
0.78 t NU as UCL4

/...

**FIGURE III**

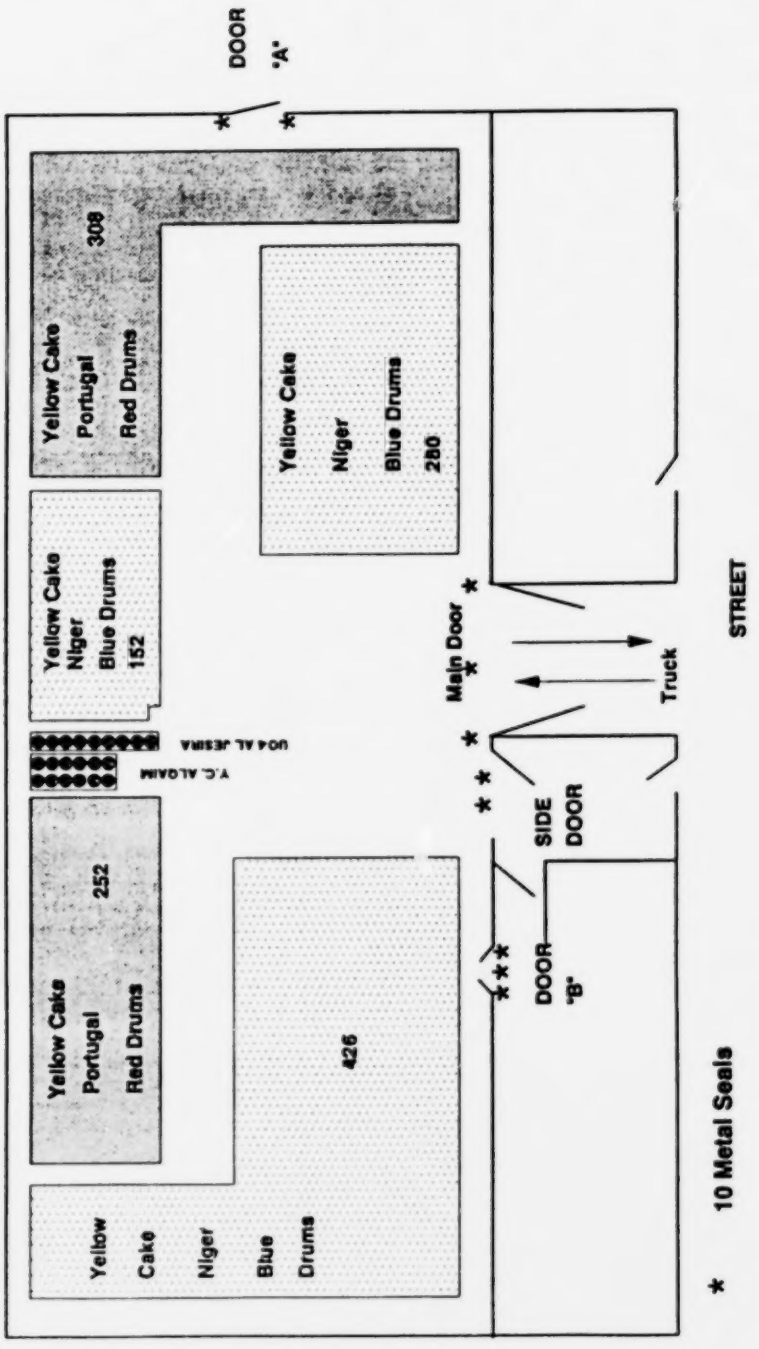
**Building 1 of Location C**


Yellow cake Portugal 100 Black Drums
UCl4 42 11 Plugs BRAZIL
1 UO4 6 mixed Ur. oxides 23 UO2 10 U3O8
BRAZIL
Yellow cake Portugal Red Drums 61
11 ADU 4 ADU Scrap 2 UO2 1 U3O8 BRAZIL
8 UCl4 Hoppers
UO2 Black Drums AL JEBIRA 186
AL JEBIRAL
UO2 Small Black Drums BRAZIL 201
UO2 3
10 Black Drums 3 Small Drums 1 Big Drum UO2
UO2 black drums AL JEBIRA 260
Yellow Cake, Red Drums Portugal 164
DOOR "D"
SIDE DOOR
MAIN DOOR
Truck
DOOR "C"
* 11 Metal Seals
STREET
* The UF6 is in the White Drum Containing Mixed U Oxides under Seal

/...

**FIGURE IV**

**Building 2 of Location C**

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Location C, Building 3 (Isotope Storage)

There are 115 radioisotopic sources stored at this location. As least nine of them are neutron sources and seven tritium sources.

During the eighth inspection, all sources were sealed, but detailed identification of them was left for a future inspection, when samples from the tritium sources should be taken. The Iraqi counterpart has been asked to provide additional information about the acquisition and utilization of the tritium sources.

Location C, Building 4

The Iraqi authorities declared that this building had been used for storing natural uranium and had been emptied after the bombing of Al Tuwaitha. Soil samples and smears were taken.

Verification activities at the IRT-5000 reactor

Verification of the nuclear material and beryllium blocks present at the IRT-5000 reactor was completed during the eighth inspection. There were 13 fuel elements in the spent fuel pond; they had previously been inaccessible for NDA verification. During this inspection, they were item-counted and four of them were randomly selected and measured by non-destructive assay techniques. The 17 beryllium blocks present at the reactor were also verified.

Verification activities at Location B

All the irradiated fuel and the beryllium blocks present at Location B were verified by seal checking.

Activities at the New Storage (Building 50 at Al Tuwaitha)

All remaining plutonium, $U^{233}$ (63 mg) and $Np^{237}$ (<0.2 g) was removed and sent to (SAL) the IAEA's Safeguards Analytical Laboratory. Nine seals were replaced.

Armour-piercing uranium penetrator programme

The Iraqi authorities have declared that 3.5 kg. of uranium metal had been used in producing ten bullets for an armour-piercing projectile programme being conducted at Hatteen. They presented three bullets and stated that three had been used for testing.

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